HELIUM

By Norbert Pacheco[1]

Sales of Grade-A helium (99.995% or greater purity) by private industry were 87.6 million cubic meters (about 3,160 million cubic feet) in the United States in 2002, and exports by private producers were 39.5 million cubic meters[2] (about 1,430 million cubic feet) for total sales of 127 million cubic meters (about 4,580 million cubic feet) of U.S. helium, about a 4% decrease from 2001 (table 1). During 2002, domestic helium sales declined by about 2%, and helium exports, by 8%; these decreases were due to a slowdown in the helium market, which can probably be attributed to U.S. economic conditions that followed the events of September 11, 2001, and increases of 15% to 20% in helium prices by the major helium producers.

Legislation and Government Programs

The Federal Helium Program was established to promote the conservation of helium in order to provide all Federal agencies with current and estimated future helium needs to carry out Government programs authorized and funded by the U.S. Congress. The major Federal helium customers were the National Aeronautics and Space Administration (NASA), the U.S. Department of Defense, and the U.S. Department of Energy. On October 9, 1996, the President signed the Helium Privatization Act of 1996 (Public Law 104-273). This legislation directed the Federal Helium Program to discontinue production and sale of refined helium by April 9, 1998. Some of the remaining key components of this legislation and applicable status updates are as follows:

- Dispose of all assets related to helium production, refining, and sales not later than 24 months after helium refinery closing.

STATUS: Through cooperation with the General Services Administration, final disposition of personal properties was completed by auction in March 2000. Through an interagency agreement with the National Park Service (NPS), the following documents were completed: the phase I cultural landscape inventory was completed in 1999 for the Amarillo and Exell helium plants and the Landis property; the historical structures inventory was completed in 1999 for the Amarillo and Exell helium plants; and Phase II archeological testing was completed for the Landis property in 2000.

A draft of a historic architectural engineering report prepared by the NPS for the Amarillo and Exell helium plants was being reviewed in 2002. An environmental contractor had been secured, and Phase I environmental assessments and health and safety plans had been completed for the Amarillo and Exell helium plants and the Landis property in 1999.

Additionally, the Landis property had been accepted into the Voluntary Cleanup Program (VCP) by the Texas Natural Resources Conservation Commission (TNRCC) in 2000. Phase II environmental site assessment work plans and initial characterization sampling had been completed for the Landis property in 2001. Final characterization and delineation sampling were completed in 2002, and lab results have been submitted to the Texas Commission on Environmental Quality (formerly the TNRCC). The Amarillo helium plant had been accepted into the VCP in 2001. No onsite remediation was required at the Amarillo plant. These results were based on characterization sampling conducted in August 2002.

- Begin selling Federal crude helium reserves in excess of 600 million cubic feet on or before January 1, 2005, and complete sales by January 1, 2015.

STATUS: Crude helium sales (in kind) for helium that is sold to Federal agencies and their contractors by private companies began in January 1998. Open market sales of the crude helium were reviewed in a legislatively mandated study conducted by the National Academy of Sciences (NAS) concerning the impact on national, scientific, and military interests. The NAS study was completed in March 2000. A notice and request for comments on the open market crude helium sale was published in the Federal Register in November 2002. The comments received were used to publish the final notice of the open market crude helium sale, and the sale was scheduled for and conducted in February 2003.

- Continue the operation of the helium storage field system, which includes the storage field and the crude helium pipeline system used for the storage and distribution of Government-owned and privately owned crude helium.
- Continue the collection of helium royalties and fees from sales of helium extracted from gas produced from Federal lands.
- Continue the helium resources evaluation and reserve tracking program to monitor helium availability for essential Government programs.
- Complete land transfer to the Texas Plains Girl Scout Council.

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[2]All metric helium volumes herein are at 101.325 kilopascals absolute (14.696 pounds per square inch absolute) and 15° C (59° F). Helium volumes, reported in parentheses following metric units, are measured in cubic feet at 14.7 pounds per square inch absolute and 70° F—1,000 cubic feet (14.7 pounds per square inch absolute and 70° F)=27.737 cubic meters (101.325 kilopascals absolute and 15° C) and 1 cubic meter (101.325 kilopascals and 15° C)=36.053 cubic feet (14.7 pounds per square inch absolute and 70° F).

Production

In 2002, 14 companies operated 24 privately owned domestic helium plants, 17 of which extracted helium from natural gas (table 2). All but two extraction plants used cryogenic extraction processes. The total sales of U.S. produced helium decreased by about 4% compared with those of 2001. All natural gas processed for helium recovery came from gasfields in Colorado, Kansas, New Mexico, Oklahoma, Texas, Utah, and Wyoming (figure 1). During 2002, 13 private plants purified helium by using pressure swing adsorption technology. Nine privately owned plants that produced Grade-A helium also liquefied helium. The plant operators and plant locations are listed in table 2.

Domestic production data for helium were developed by the U.S. Bureau of Land Management (BLM) from records of its own operations as well as from its own high-purity helium survey, a single voluntary canvass of private U.S. operations. Of the 10 operations to which a survey request was sent, 100% responded, and those data plus data from BLM operations represent 100% of the total helium sales and recovery data shown in table 3.

Domestic measured helium reserves and indicated helium resources as of January 1, 2001, were estimated to be 8.9 billion cubic meters (323 billion cubic feet). The resources included measured helium reserves estimated to be 4.1 billion cubic meters (147 billion cubic feet) in natural gas from which helium is being extracted. The measured reserves included nearly 951 million cubic meters (34.3 billion cubic feet) stored by the BLM in the helium storage conservation system. Measured helium reserves from indicated resources of natural gas with helium content greater than 0.05% were estimated to be 1.8 billion cubic meters (65 billion cubic feet). Indicated helium resources, a category of reserves slightly less certain than measured reserves, in natural gas with less than 0.3% helium were estimated to be 3.1 billion cubic meters (111 billion cubic feet). The majority of these indicated reserves were derived from the Potential Gas Committee designation of unconfirmed/probable reserves (Curtis, 2000). Approximately 2.6 billion cubic meters (94 billion cubic feet), or 98%, of the domestic helium reserves that are under Federal ownership and from which helium is being extracted, is located in the Riley Ridge area in Wyoming and the Cliffside Field in Texas.

Most domestic helium resources are in the Midcontinental and Rocky Mountain regions of the United States. The measured helium reserves are in approximately 102 gasfields in 11 States. About 97% of these reserves is contained in the Hugoton Field in Oklahoma, Kansas, and Texas; the Panoma Field in Kansas; the Keyes Field in Oklahoma; the Panhandle West and the Cliffside Fields in Texas; and the Riley Ridge area in Wyoming. During 2002, the BLM analyzed 207 natural gas samples from 10 States in conjunction with its program to survey and identify possible new sources of helium.

Consumption

In 2002, private industry supplied 100% of the domestic demand. The major domestic end uses of helium were cryogenics (24%), pressurizing and purging (20%), welding (18%), and controlled atmospheres (16%). Minor uses included leak detection (6%), synthetic breathing mixtures (3%), and chromatography/lifting gas/heat transfer (13%) (figure 3). Cryogenics, specifically magnetic resonance imaging applications, dominated liquid helium use. Estimated 2002 domestic consumption by end use was based on a 1996 end-use survey conducted by BLM's Helium Operations to determine the trends in helium usage.

In-kind crude helium sales regulations (43 CFR part 3195), which became effective on November 23, 1998, require that helium refiners that sell helium to Federal agencies and their contractors must buy an equivalent amount of crude helium from the BLM. Such sales are referred to as "in-kind crude helium sales." In 2002, in-kind crude helium sales were 6.3 million cubic meters (228 million cubic feet). The sales were made by eight companies through contracts with the BLM.

Stocks

The volume of helium stored in the BLM helium conservation storage system, including the conservation pipeline network and the Cliffside Field, totaled 867 million cubic meters (about 31 billion cubic feet) on December 31, 2002. The storage system contained crude helium purchased under contract by the BLM from 1962 to 1973 and privately owned helium extracted by industry from natural-gas-supplying fuel markets and stored under contract. This privately owned helium is returned to the owners as needed for purification to supply private demand. During 2002, 16.6 million cubic meters (598 million cubic feet) of private helium were delivered to the BLM's helium conservation system, and 56.3 million cubic meters (about 2,030 million cubic feet) were withdrawn for a net decrease of 39.7 million cubic meters (about 1,430 million cubic feet) of private helium in storage (table 4).

Transportation

Private producers and/or distributors shipped helium, predominantly as a liquid, in semitrailers. These semitrailers delivered the liquid helium to distribution centers where some of it was gasified and compressed into trailers and small cylinders for delivery to end users. The remaining liquid helium was sold as bulk liquid or repackaged in dewars of various sizes for delivery.

Prices

The price charged by the BLM for crude helium to private companies for in-kind crude helium sales was $1.857 per cubic meter ($51.50 per thousand cubic feet) for fiscal year 2002.

Foreign Trade

In 2002, exports of Grade-A helium decreased to 39.5 million cubic meters (1.43 billion cubic feet) (table 1). Helium exports decreased by about 8% compared with those of 2001 and accounted for about 31% of the U.S.-produced helium sales; private industry supplied all U.S. helium exports. The decrease in helium exports is due to a slowdown in the helium market, which can be attributed to the economic conditions that followed the events of September 11, 2001, and helium price increases of 15% to 20% by the major helium producers. About 49% of the helium exported from the United States went to Asia, with Japan receiving about 29% of exports to Asia. About 28% of the exported helium was shipped to Europe; collectively, Belgium, France, Germany, and the United Kingdom received 98% of the helium exported to Europe. Other exports were as follows: Canada and Mexico, 7%; South America, 6%; Australia and New Zealand, 4%; the Middle East, 4%; Africa, 1%; and Central America and the Caribbean, less than 1% each. Import tariffs on helium established on January 1, 1998, remained at the 3.7% rate for normal trade relations (NTR) nations and at the 25% for non-NTR nations.

World Review

Excluding the United States, world production capacity of helium remained at an estimated 29 million cubic meters (1.05 billion cubic feet). All known helium that was produced outside of the United States in 2002 was extracted in Algeria, Poland, and Russia (table 5).

Outlook

In 2002, the total market for U.S.-produced helium decreased by 3.8% compared with that of 2001. From 1997 to 2002, the market growth rate was about 3.5% per year. From 1992 to 2002, the market growth rate was about 2.6% per year.

Expansion of the Asian helium market during the next several years is expected to be moderate owing to the uncertain economic conditions in that region of the world. Competition from foreign helium producers will provide continued uncertainty in the strength of U.S. exports to the global helium market. U.S. produced helium sales are expected to remain level during the next 1 to 2 years because of uncertain domestic economic conditions.

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TABLE 1
TOTAL SALES OF GRADE-A HELIUM
PRODUCED IN THE UNITED STATES[1]

(Million cubic meters)

	Volume		
Year	Domestic sales	Exports[2]	Total sales
1998	84.2	27.8	112
1999	89.8	26.8	117
2000	89.6	37.0	127
2001	89.0	43.0	132
2002	87.6	39.5	127

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Source: U.S. Census Bureau.

TABLE 2
OWNERSHIP AND LOCATION OF HELIUM EXTRACTION PLANTS IN THE UNITED STATES IN 2002

Owner or operator	Location	Product purity
Air Products and Chemicals, Inc.	Hansford County, TX	Grade-A helium.[1]
Do.	Liberal, KS	Do.
BCCK Engineering, Inc.[2]	Dodge City, KS	Crude helium.
BOC Gases, Inc.	Otis, KS	Grade-A helium.[1]
BP plc	Sunray, TX	Crude helium.
Do.	Ulysses, KS	Do.
Cardinal Resources, Inc.[3]	Chillicothe, TX	Grade-A helium.
CIG Co. (a subsidiary of El Paso Corp.)	Keyes, OK	Do.[1]
Do.	Lakin, KS	Crude helium.
Duke Energy Field Services	Cheyenne Wells, CO	Crude and Grade-A helium.[1]
Do.	Hansford County, TX	Crude helium.
Do.	Liberal, KS	Do.
Do.[4]	Borger, TX	Do.
Do.[5]	Dumas, TX	Do.
Exxon-Mobil Corp.	Shute Creek, WY	Crude and Grade-A helium.[1]
Newpoint Gas Services, Inc.[6]	Shiprock, NM	Grade-A helium.
ONEOK, Inc.[7]	Bushton, KS	Crude helium.
Do.[8]	Scott City, KS	Do.
Pioneer Natural Resources Co.	Fain, TX	Do.
Do.	Satanta, KS	Do.
Praxair, Inc.	Bushton, KS	Grade-A helium.[1]
Do.	Ulysses, KS	Do.
Tom Brown, Inc.	Moab, UT	Crude and Grade-A helium.[1]
Williams Field Services Co.[9]	Baker, OK	Crude helium.

[1]Including liquefaction.
[2]Plant started up in June 2002.
[3]Plant sold to Newpoint Gas Services, Inc. and shut down in March 2002.
[4]Plant started up in October 2001.
[5]Plant shut down in April 2002.
[6]Plant started up in late 2002. This plant is the old Cardinal Resources Chillicothe, TX, plant.
[7]Plant was shut down for the first 8 months of 2002. Restarted in September 2002.
[8]Output is piped to Ulysses, KS, for purification.
[9]Plant sold to Duke Energy and shut down in February 2002.

TABLE 3
HELIUM RECOVERY IN THE UNITED STATES[1, 2]

(Thousand cubic meters)

	1998	1999	2000	2001	2002
Crude helium:					
Bureau of Land Management (BLM) total storage	(100)	--	--	--	--
Private industry:					
Stored by BLM	33,000	32,000	23,300	18,000	16,600
Withdrawn	(31,400)	(35,100)	(51,900)	(62,900)	(56,300)
Total private industry storage	1,600	(3,100)	(28,600)	(44,900)	(39,700)
Total crude helium	1,500	(3,100)	(28,600)	(44,900)	(39,700)
Grade-A helium:					
BLM sold	2,000	--	--	--	--
Private industry sold	110,000	117,000	126,600	131,900	127,100
Total sold	112,000	117,000	126,600	131,900	127,100
Total stored	1,500	(3,100)	(28,600)	(44,900)	(39,700)
Grand total recovery	114,000	114,000	98,000	87,000	87,400

-- Zero.

[1]Negative numbers are enclosed in parentheses to denote net withdrawal from the BLM's underground storage facility, a partially depleted natural gas reservoir at the Cliffside Field near Amarillo, TX.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 4
SUMMARY OF BUREAU OF LAND MANAGEMENT HELIUM CONSERVATION STORAGE SYSTEM OPERATIONS[1, 2, 3]

(Thousand cubic meters)

	2000	2001	2002
Helium in conservation storage system on January 1:			
Stored under BLM conservation program[4]	841,000	836,000	829,000
Stored for private producers under contract	138,000	116,000	78,000
Total[4]	979,000	952,000	907,000
Input to system:			
Net deliveries from BLM plants	--	--	--
Stored for private producers under contract	23,300	18,000	16,600
Total[4]	23,300	18,000	16,600
Redelivery of helium stored for private producers under contract	(51,900)	(62,900)	(56,300)
Net addition to system[4]	(28,600)	(44,900)	(39,700)
Helium in conservation storage system on December 31:			
Stored under BLM conservation program[4]	836,000	829,000	822,000
Stored for private producers under contract	116,000	78,000	45,000
Total[4]	952,000	907,000	867,000

-- Zero.

[1]Crude helium is injected into or withdrawn from the BLM underground storage facility, a partially depleted natural gas reservoir at the Cliffside Field near Amarillo, TX.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]Numbers in parentheses indicate net withdrawal from storage.

[4]Net additions to system do not include in-kind crude sales or transfers. However, totals do include crude sales and transfers.

TABLE 5
WORLD GRADE-A HELIUM
PRODUCTION ANNUAL
CAPACITY, DECEMBER 31, 2002

(Million cubic meters)

	Capacity
United States[1]	152
Rest of world[e]	29
Total[e]	181

[e]Estimated.
[1]Includes plants on standby as well as operating plants.

FIGURE 1
MAJOR U.S. HELIUM-BEARING NATURAL GAS FIELDS

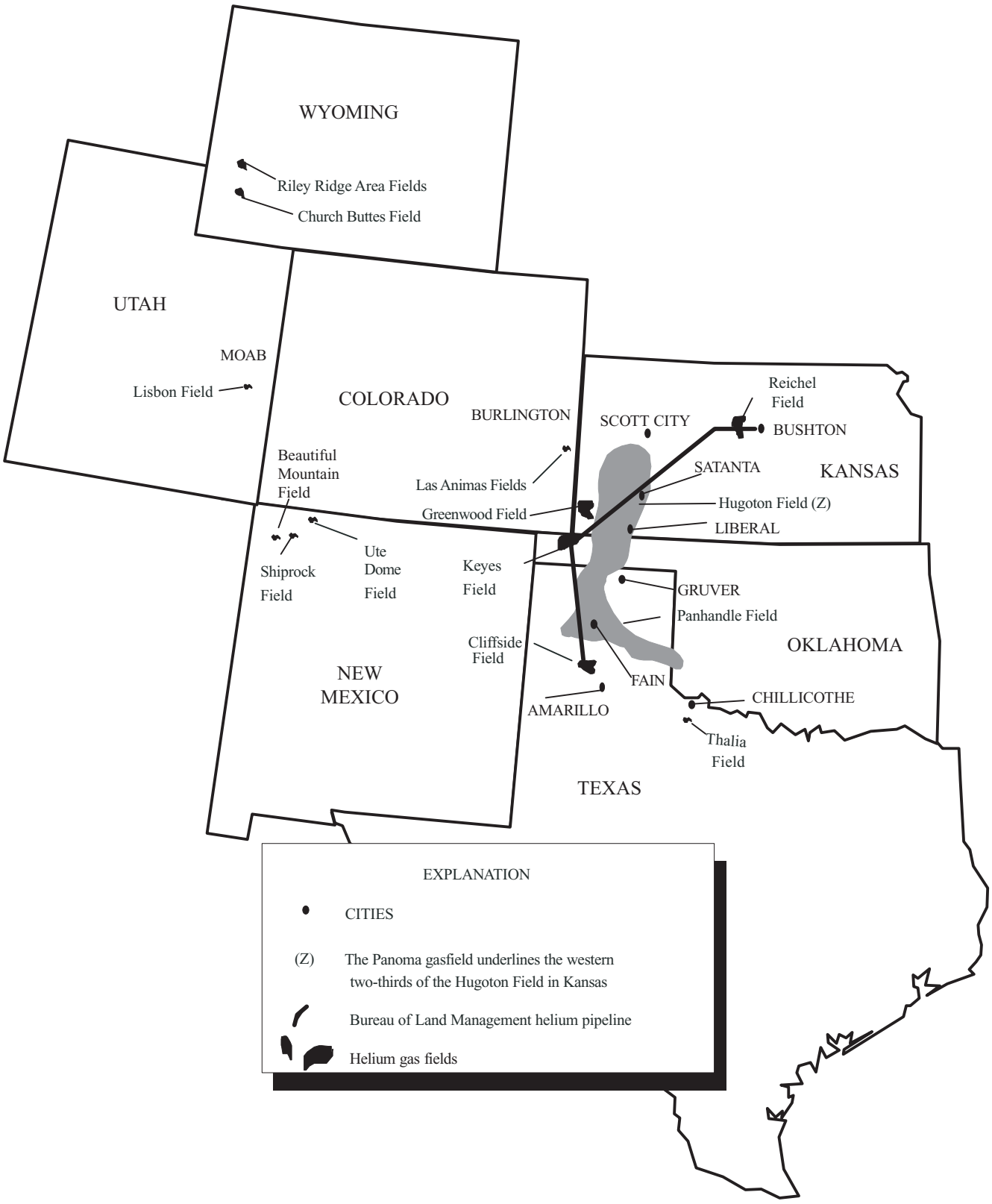


FIGURE 2
HELIUM RECOVERY IN THE UNITED STATES

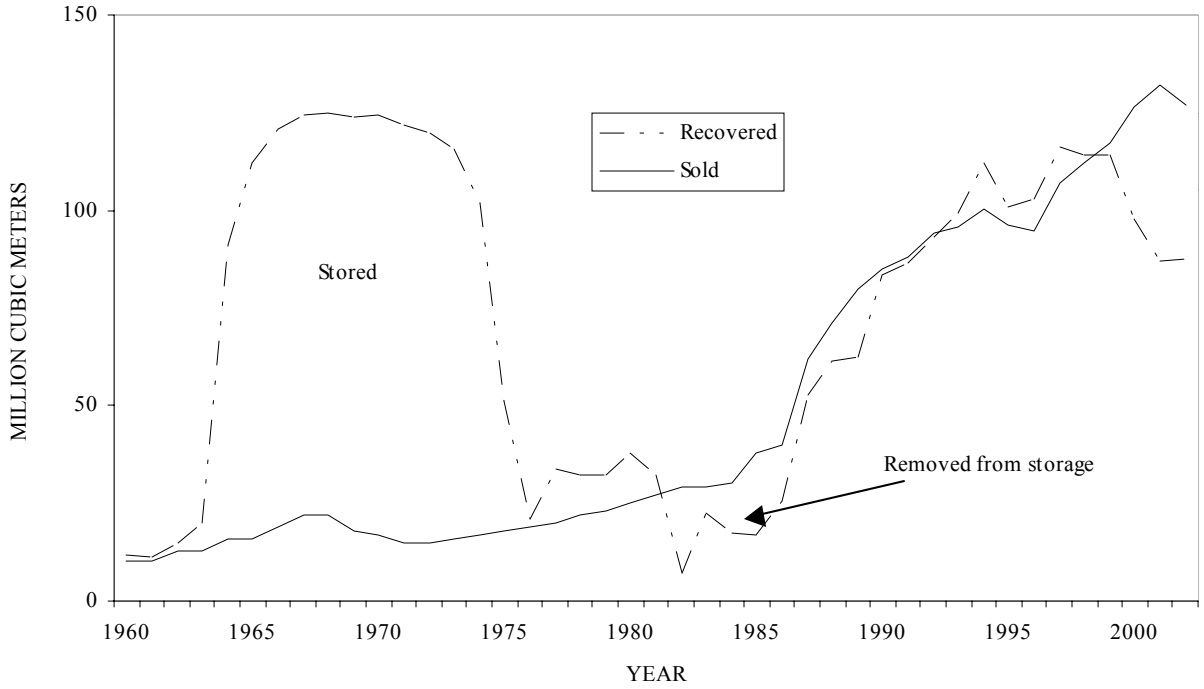
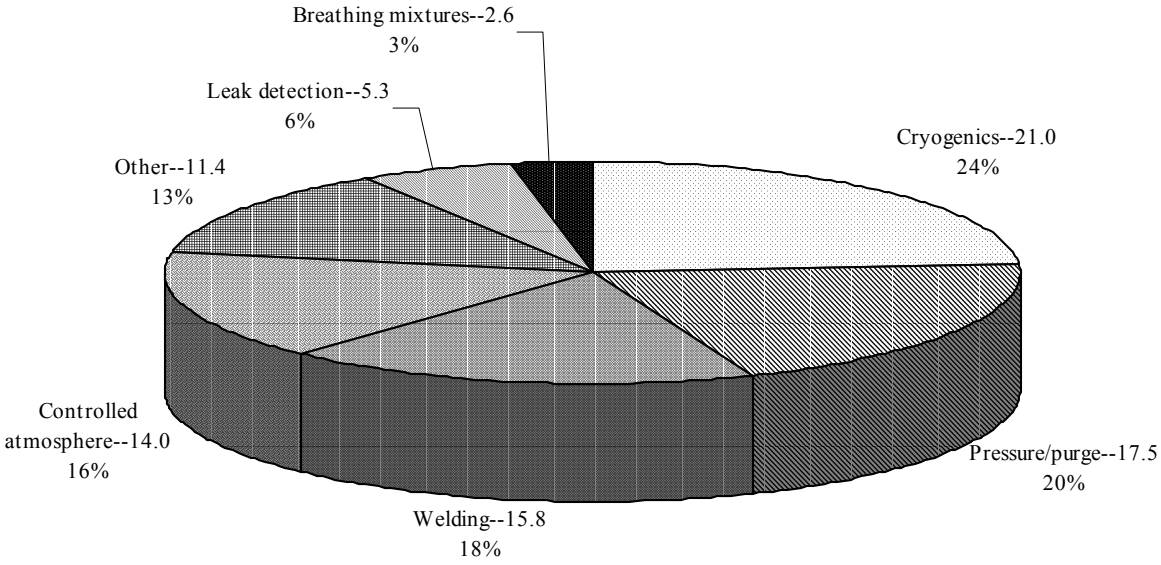


FIGURE 3
ESTIMATED HELIUM CONSUMPTION IN THE UNITED STATES IN 2002, BY END USE[1]

(Million cubic meters)



[1]Total helium used in 2002 was estimated to be 87.6 million cubic meters.